gold or other metal of value deposited in this altered rock. Intense hydrothermal alteration of the rocks is widespread along the north side of the valley of Howard Fork and is present in a few other places. Solutions that produced the alteration also appear to have deposited disseminated ore minerals in the country rock; but this type of mineral deposit has been mined only rarely.

Mineralizing solutions were apparently available over a considerable period of time and must have changed their composition considerably from time to time. Therefore, the kind and amount of mineral deposited in any fracture depended on when the fractures were open. Fault zones of almost any bearing may contain one or more of the different types of deposits listed below. The same zone may also have different types in it at different places along its extent. The longer fault zones opened up more often and therefore had a better chance of having worthwhile ore deposits formed along them.

The different types of deposits of mineralized rock in the South Telluride area are as follows:

Barren veins:
- Calcite only
- Quartz, with or without calcite
- Quartz and pyrite
- Quartz, barite, with or without fluorite, with or without pyrite

Gold-bearing veins:
- Quartz
- Quartz and pyrite
- Quartz, barite, sparse pyrite, and galena, with or without fluorite

Base-metal veins:
- A gangue in most places made up of quartz, ankerite, barite, with or without rhodochrosite, fluorite, gypsum or calcite. Pyrite almost everywhere. The valuable metals are contained in chalcopyrite, tetrahedrite, galena, sphalerite; one or more of them may be absent. Silver almost always present, gold abundant enough in places to be recoverable.
- Rhodochrosite and galena, generally rich in silver.
- Replacement deposits consisting of relatively large volumes of intensely hydrothermally altered rock made up of sericite, quartz, clay, and disseminated pyrite; may contain disseminated gold and many small veinlets carrying quartz and gold; other valuable metals may be disseminated in the rock in small amounts.

AREAL DISTRIBUTION OF VEINS

In general the veins north of the latitude of the outlet of Blue Lake have been mined mostly for gold. Many of them contain gold, quartz, and pyrite, a few contain only gold and quartz, and a few contain sparsely distributed base-metal minerals besides. Most of them occupy the westward-trending fault zones, but a few occur in fractures of other directions. Deposits in the southern parts of the Bridal Veil and Bear Creek drainage areas and in the southwestern section in gen-

eral have been mined for both gold and silver but contain considerable amounts of base-metal minerals as well. The relatively small ar from the Gold King mine to the Telluride formation south of the Su folk mine has produced principally gold from both veins and dissem nations in altered country rock. Most of the deposits in the Howa Fork valley have yielded silver, lead, and copper from base-met veins; the area just north and east of the Ophir Needles intrusion h a somewhat special type of deposit containing silver in galen rhodochrosite veins. Quartz and quartz-pyrite veins are so widespread that they will not be specifically mentioned, but they should not neces sarily be ignored in prospecting.

For convenience of description, the area will be divided into th same sections as were described in the chapter on "Structure."

EASTERN SECTION

Most of the ore deposits of the north half of the eastern section li in the westward-trending structural zones and are valuable princi pally for gold. Some contain also sparse amounts of galena and chalcopyrite. A few of northeast and northwest trend have also been developed.

A special type of deposit containing fluorite in addition to the usual vein minerals occurs in the northern end of the eastern section. Included in this type are the Millionaire vein zone, the westward-trending veins just south of the Mayflower mine, a vein 900 to 1,000 feet north of this one, and a few others of northwest trend. These veins contain fluorite and quartz of two or three ages. The Millionaire vein zone shows the usual paragenetic relations (p. 275) but in addition, after stage 6, (deposition of fine comb quartz on margins of vugs, followed by deposition of a clay mineral and pyrite) there was a period of minor fracturing, followed by the leaching out of some fluorite and barite, then deposition of fine-grained drusy quartz. According to Purington (1898) the mine on the northeast side of Deertrail Basin, at an altitude of 11,434 feet (pl. 16) produced gold in the early days. It is not known at what stage the gold was deposited, but it may have been at stage 6 (p. 275) or, less likely, at stage 4. The fact that only one successful mine was developed along the Millionaire fault suggests that not much gold came into it.

Gold is in most of the westward-trending systems of veins south to the latitude of Blue Lake. These include the Champion-Dividend zone (pls. 17 and 18), the vein on which the Royal mine (pl. 19–*G*) is located, the one about 1,000 feet north of the Royal Mine (believed to be the Waterfall vein), and the one about 1,600 feet south of the Royal mine (on which the mine at altitude 11,575 feet is located);

some of these veins, such as the Royal vein, contain sparse base-metal minerals. The fault zone on which the vein of the Royal mine lies appears to continue westward to the La Junta mine (which produced a small amount of gold) on the east side of La Junta Basin, and to cross the basin to the west side, where it is coextensive with a group of west-northwestward-trending veins containing base-metal sulfides, quartz of four stages, and probably some gold. The vein about 1,600 feet south of the Royal mine extends westward to the east side of La Junta Peak, and the zone of fractures in which it lies continues across the north side of La Junta Peak, trending about N. 62° W. In the Orient mine, from which minor amounts of gold were also produced, apparently a vein in this zone was explored on the east side of La Junta Basin. Farther south, in the vicinity of the Little Dorrit and Lewis mines, there are fewer westward-trending veins, and those observed do not appear to be gold bearing.

The northeastward-trending veins generally contain only pyrite and one or two stages of quartz. These veins rarely contain gold. Although the shaft of the Mayflower mine goes down on one of them, it is believed that any gold produced probably came from the westward-trending vein about 200 feet south of the shaft, as this vein is part of a main fracture along which gold is known to occur elsewhere (Dividend zone, pl. 18). The small mine on the north side of Grays Basin (altitude 11,935, pl. 19*D*) has one stope from which gold was presumably produced. The northeastward-trending vein that passes under Mud Lake has galena and sphalerite in a quartz-carbonate-pyrite gangue where it crosses the ridge southeast of Mud Lake. The Wasatch fault (pl. 17) contains galena in a quartz vein at the head of Jackass Basin.

Most of the northward-trending fractures, many of which actually strike a little west of north, contain only quartz-pyrite veins. The mine on the west side of Bridal Veil Creek, between the creeks draining Jackass and Silver Lake Basins (altitude 10,883, pl. 18), does, however, contain some galena and chalcopyrite in a gangue consisting of quartz of two ages, pyrite, and ankerite.

The richer looking deposits in the southern part of the eastern section consist of base-metal veins on northward-trending fractures in the South Bridal zone (pl. 17) and, in Bridal Veil Basin itself, on northeastward-trending fractures of the Lewis zone. These base-metal veins contain chalcopyrite, tetrahedrite, galena, and sphalerite in a gangue that consists of quartz of at least two ages, some ankerite, and barite; they contain silver and probably some gold.

Southwest of the Millionaire fault two northward-trending veins contain base metals. One trends south from a point about 150 feet

west of U.S.M.M. Pulaski, and in places contains base-metal sulfi in a gangue of silicified gouge and comb quartz. These two v zones converge southward and apparently join into the single v that is explored by the Little Dorrit mine. This mine is caved the portal, but considerable base-metal material occurs on the dun Farther south the Lewis mine is on the same vein zone; its lar dumps also contain considerable base-metal minerals.

Several base-metal veins in Bridal Veil Basin, from the Little Do rit mine south to Lewis Lake and across the full width of the basi trend in general between N. 45° E. and N. 75° E., and contain cha copyrite, tetrahedrite, galena, and sphalerite in places in a gangu consisting of quartz, pyrite, ankerite, and barite. This occurrence rather unexpected, as the veins cut, and were mined in, the Burn latite and the lowest member of the Potosi volcanic series. Excep for a few small mines on the southeast side of Blue Lake (perhaps a eastward extension of the same zone), this is the only place wher base-metal minerals were seen as high in the rock column as the Potos volcanic series, which in other places seems to be very unfavorabl for the formation of veins that contain anything but quartz and py rite. The presence of these base-metal veins in the Potosi volcani series is, therefore, an indication of an area of particularly intense min eralization that may have important ore bodies in the much more favorable San Juan breccia buried below (p. 277). There is the possibility that this group of veins lies in the broad zone of structural disturbance extending approximately from the Badger tunnel in the valley of Howard Fork almost to Blue Lake (p. 259, 266 and pls. 16 and 17).

WESTERN SECTION

In general the deposits in the western section like those of the eastern section, contain mostly gold in the northern half, but towards the south contain increasing amounts of base-metal minerals, so that around U.S.M.M. Delta, and farther south they are base metal veins containing considerable silver and gold. Most of the deposits to the north lie in the westward- to west-northwestward-trending structural zones, whereas around U.S.M.M. Delta some also are on both the northeast and northwest structures.

A relatively large area, where gold has been mined from veins having several different trends, lies along the Champion-Dividend fault zone (pl. 17) where it intersects the south-southwestward-trending boundary zone. This area will be referred to hereafter as the Weller area, after a mine within it. Quartz veins within this Weller area are present in several groups of fractures; these include veins trending between N. 50° W. and N. 65° W., veins trending between N. 10° W.

and N. 25° W., and at least one vein about N. 20° E. The veins generally contain quartz of three or four ages and some pyrite; many must have contained moderate amounts of gold, to judge by the large amount of digging done on them. Besides the Weller and Champion mines there are many opencuts and small adits. The mine at the north edge of the area (altitude 11,690 feet) has been stoped to the surface for a considerable distance along a vein that strikes N. 20° E. A small mine on the east side of Ballard Mountain is shown as *A*, plate 19. The mine, 700 feet S. 40° E. of the Weller mine, has a fair-sized dump. The Weller mine itself must have been important for the production of gold at one time, as a tram line went down N. 32° W. to Bear Creek, and this tram apparently had considerable use. According to Purington (1898), the quartz veins in this area contain gold and very little pyrite. He further states that the Champion mine was worked only in the conglomerate (Telluride formation) where the fissured zone is a fault breccia in which a solid vein of quartz contains little else than gold.

The Contention mine (altitude 10,375, pl. 16) west of Bear Creek lies on line with the Champion-Dividend zone, but the vein strikes about N. 75° E., at an angle to the zone. The mine is completely caved and inaccessible, but according to Purington (1898), the vein was worked in the conglomerate (Telluride), where the fissured zone is marked by a fault breccia filed with quartz containing gold and very little pyrite. Where the vein was observed during this study at a higher altitude in the San Juan breccia, it shows silicified and pyritized rock, fractured, and filled with comb quartz and a little pyrite.

Farther south along Bear Creek are the Canton, Maryland, Silver Chief, and Fairview mines (pl. 20*B*, *D*, *I*, *H*). These develop some of the veins on the west to N. 70° W. group of faults (pl. 17). All the veins have approximately similar mineralogy; the wall rock is somewhat silicified, two or three generations of quartz make up the vein and contain some pyrite and, in places, gold. The Canton mine (pl. 20*B*) has been stoped on three levels and produced much profitable ore. The Maryland (pl. 20*D*) and Fairview (pl. 20*H*) mines have had somewhat less production. Other gold producers along Bear Creek mentioned by Purington (1898) but not definitely located during this study are the Northern Ohio and Elizabeth mines.

On the east side of the canyon, in the great cliffs on the west side of the ridge between La Junta Basin and Bear Creek, are a number of veins trending about N. 50° W. on the average. Only some have mines along them, but they are basically similar and any of them could contain undiscovered gold-bearing ore shoots. The Savage

mine (pl. 20*C*), from which a small amount of high-grade gold o was produced, is on a vein near the north end of this group of vei at altitude 11,709 feet, in La Junta Basin.

The vein in the Silver Chief mine has somewhat different mine alogy. Chalcopyrite and galena occur in a gangue consisting pyrite and two stages of quartz; Purington (1898) reports the pre ence also of sphalerite, mispickel (arsenopyrite?), calcite, and ser cite. He further describes the vein in this mine as being as muc as 9 feet wide, as showing crustification and ribbon structure alon the sides (probably due to reopening), and as being essentially silver bearing. This vein apparently is alined with the vein in the Fairvie mine on the west side of the canyon and with another quartz-pyrit vein on the east side. Another vein in the Cutler formation, S. 67° E. from the portal of the Canton (the Northern Ohio?), also show chalcopyrite, galena, and sphalerite on the dump of the adit in the Culter formation, although up in the Telluride formation and the San Juan breccia only quartz and pyrite were seen in the vein.

The next productive fault zone to the south is that on which the Wasatch and Nellie mines are located (pl. 20*J*, *K*). It is a pronounced echelon zone that extends from the west side of La Junta Basin across the north end of Gold Hill. West from the ridge on the west side of La Junta Basin it is offset to the north twice at distances of about 200 and 300 feet, and on the slope of Gold Hill it is offset to the south somewhat; conversely underground observations show that along strike to the west this structure is offset repeatedly 2 to 4 feet to the north in the Nellie mine, and perhaps also in the Wasatch mine. The veins on the offsetting fractures consist of two and three stages of quartz, with pyrite and, in places, gold. In the Nellie mine, intense hydrothermal alteration has converted the country rock along the veins to a soft clayey material that may carry some gold.

Farther south a large, irregular shaped area is characterized by the presence of considerable amounts of base metals in the veins. This area, hereafter called the Delta area, can be considered as surrounding U.S.M.M. Delta between the Lena fault and the Boundary zone. A western extension of this area is the west slope of Gold Hill. Within this general area several veins contain at least some of the base-metal minerals, such as galena, sphalerite, chalcopyrite and, in places, tetrahedrite, in a gangue more complex than that of the gold-bearing veins to the north. Barite, ankerite, in places much pyrite, and some rhodochrosite (as indicated by heavy manganese oxides) are present in addition to the quartz, which generally is of three or four ages. Some of these veins must contain considerable amounts of silver, or gold, or both metals, judging by the number of small abandoned mines with

fair-sized dumps. None of the mines were accessible except the one east of U.S.M.M. Delta (pl. 20*L*), marked altitude 11,640 feet on plate 16. This mine is on the most continuous vein in the Delta area; the vein extends from the west side of Wasatch Mountain a little south of west to Prospect Basin.

Other veins with westward and northeastward trend are common, and there are a few with northwestward trend, and at least two with northward trend. One of these, on the Lena fault (pl. 17), contains sulfides in a quartz-barite gangue in the flows at the top of the Burns latite. Within the Delta area is also an area of extremely altered rock where a number of rather closely spaced fractures in several different directions occur; this area is in a narrow canyon along the East Fork of Bear Creek, about 1,000 feet north of the mine at altitude 11,640 feet. This area contains rocks that are replaced by sericite, clay, and pyrite, and has a number of quartz veins of different trends.

SOUTHWESTERN SECTION

Base-metal veins in the southwestern section occur on northwestward- and northeastward-trending faults. In the southern part of the section there are a group of galena-rhodochrosite veins containing a considerable amount of silver near the Ophir Needles intrusion, and one northward-trending vein zone associated with a mass of hydrothermally altered rock from which gold has been produced.

A group of veins trending between N. 30° E. and N. 60° E., and an intersecting group trending between N. 45° W. and N. 70° W., contain at least one, and generally several or all, of the base-metal minerals, chalcopyrite, galena, sphalerite and tetrahedrite, in the usual type of complex gangue found with the base-metal minerals; rhodochrosite may be more abundant here than farther north or east. In places, these veins are high in silver, especially those reportedly high in galena and tetrahedrite (freibergite?), and have also been enriched by later-formed gold-quartz veins introduced approximately along the same fractures. Near the surface supergene enrichment in silver must have taken place by the formation of sulfosalts, argentite, and native silver, and in gold by the oxidation and leaching out of base-metal minerals and pyrite; this is indicated by the large production of gold and silver in the early days from many small mines in the shallow oxidized zone. The property of the Alta Mines, Inc., which is the largest in the area and most recently operated, is described in somewhat more detail on pages 288–293.

In the area from approximately 1,500 feet east and west of the north end of the Ophir Needles northeast to the cliffs southwest of the lake in Gold King Basin are a number of veins of diverse trend (mostly north and north-northeast, but some east) which contain an exceptional

644511—62——6

amount of rhodochrosite, judging from the large amounts of manganese oxide in the outcrops; the rhodochrosite is accompanied by some barite, quartz, and pyrite. Most of the veins presumably contain some base-metal minerals and silver. No large mines occur in this area, but again many small, near-surface mines, now inaccessible, are present. Extending across the notch northeast of Ophir Needles is an area of iron-stained intensely altered rock containing considerable amounts of clay and manganese oxide in the outcrop.

A special situation exists in the general area from the Gold King mine south past the Suffolk mine and down into the Telluride formation south of the Suffolk mine. Little could be observed during this study, and what follows is based almost entirely on Purington's description (1898). In this area there are many small quartz veins of diverse strike that are not shown on the map (pl. 16). The country rock between all these veins is much altered and considerable pyrite has been introduced. The quartz veins themselves and the altered country rock contain appreciable amounts of gold, probably in or accompanying the pyrite. This situation exists as far south as the conglomerate of the Telluride formation. (See notes for Gold Crown on p. 298). Both the quartz veins and the altered pyritized country rock in this area have therefore been stoped. Old stopes caved to the surface can be seen along the Gold King vein north of the Suffolk portal shown on the map (pl. 16). Originally a number of separate small mines were worked in this area. (See notes for Globe, Gold Crown, and Suffolk on p. 297, 298, 302.) Later they were combined into a single property, worked mostly through the Suffolk portal (altitude 11, 321, pl. 16). The ore was sent by aerial tramline to a mill near Ophir.

SOUTHERN SECTION

Aside from a few northward-trending quartz veins and the disseminated gold ore around the Suffolk mine, already described, most of the veins on the north side of the valley of Howard Fork trend either within 10° of N. 65° E., or approximately east. All these veins contain one, though generally more than one, of the base-metal minerals, galena, sphalerite, chalcopyrite, and tetrahedrite, in a gangue of pyrite, quartz of several ages, and in places barite, ankerite, rhodochrosite, or gypsum. Most of them also contain considerable amounts of silver and some gold. Some of the near-surface (secondarily enriched?) ore shoots mined in the early days must have been exceptionally rich in silver, as the ore was sent by pack train over Ophir Pass to smelters at Silverton. The Crown Point mine workings (pl. 21*J*) were in a replacement deposit in metamorphosed limestone of the Pony Express member that contained silver-rich tetrahedrite, galena,

and chalcopyrite. A few deposits contain some molybdenite and a little hubnerite. Near and east of Chapman Gulch only quartz-pyrite veins containing a little gold are present. A large area of intensely hydrothermally altered rock containing very low amounts of base-metal minerals extends from Spring Gulch to Chapman Gulch. All the accessible workings of the mines on the north side of the Howard Fork valley are shown on plate 21, with notes regarding the local geology.

The group of veins trending within 10° of N. 65° E. lies in the broad zone of structural disturbance that extends from the Badger tunnel to Blue Lake, and presumably farther northeast. (See 259, 266.) The following veins belong to this group and most contain base-metal minerals: the vein 570 feet from breast of the Badger tunnel (pl. 21*G*); two or three veins explored by the Osceloa and Gertrude workings (pl. 21 *A*, *F*); two veins about 2,200 feet N. 50° E. of the New Dominion portal (pl. 16); three veins explored by the Carbonero mine (pl. 21*H*), on one of which the Highline mine also lies; the veins explored by the workings in the Silver Tip mine (pl. 21*B*); the vein about 1,000 feet N. 35° E. from the Illinois tunnel as well as a number of veins within that adit (pl. 21*I*); and the vein explored by the Calumet mine (pl. 21*C*). Perhaps also the several faults and altered zones that lie across the main ridge northwest of the unnamed peak (altitude 13,614 feet) north-northwest of Lookout Peak are a part of such a broad zone.

The Carbonero mine (pl. 21*H*) has probably had the largest production of any mine on the north side of the valley of Howard Fork. According to data supplied by W. B. Meek (written communication), from 1907 to 1941 the mine produced a total of 101,662 tons of ore containing an average of 0.024 ounce gold, 8.7 ounce silver, 6.99 percent lead, 4.7 percent zinc, and 0.16 percent copper. The vein farthest north, the Carbonero vein, strikes between N. 50° E. and N. 85° E., averaging N. 75° E.; the average dip is 80° N. This vein is as much as 36 inches wide, averaging 12 inches, and consists of one to four stringers of sulfides in gangue or altered country rock. The sulfides, in the order of decreasing abundance, are pyrite, galena, sphalerite and chalcopyrite; the nonmetallic minerals are gypsum, quartz, calcite, and, rarely, rhodochrosite. The next vein south, the Panama, has an average strike of about N. 55° E., and a steep dip to either the northwest or southeast. The Panama vein is considerably narrower than the Carbonero, being only 1 to 6 inches wide but consists of almost solid sulfides, (sphalerite, galena, pyrite, and chalcopyrite, in order of abundance) with a sparse gangue of quartz and gypsum. Not much can be seen of the third vein in the Carbonero mine, that

at the portal, but a fault breccia cemented by limonite and containi some quartz and galena was noted.

So far as observed the eastward-trending veins show about the sa mineral content as the northeastward-trending veins. Mines in whi ore was produced from veins of this direction are the Osce (pl. 21*A*), the Santa Cruz (pl. 21*D*), and the New Dominion (pl. 21*K*); other mines, now inaccessible, probably worked similar vei Some can be seen also on the maps of the Silver Tip mine (pl. 21*B* the Badger tunnel (pl. 21*G*), and the Crown Point mine (pl. 21*J*

Several small veins containing quartz, pyrite, clay, scarce base-met minerals, and some gold are exposed along Chapman Gulch and ea as far as Lookout Peak. They trend in general west and northwes The gold content of these veins was sufficient so that considerable stop ing, some extending to the surface, was done.

Molybdenite in small quantities can be seen at several places in th Howard Fork valley. It generally is associated closely with th quartz-feldspar porphyry intrusions. A little is in small veinlets i the New Dominion mine (pl. 21*K*); in the lower level of the Silve Tip (or Yellowjacket mine) (pl. 21*B*) it occurs as a thin coating o joint faces for about 400 feet along the crosscut. Some rather coarsely crystalline but rare masses occur in the breccia pipe replaced by quartz and sericite in the gulch west of Chapman Gulch. A little hubnerite occurs with the molybdenite in places.

From a short distance west of Spring Gulch to the east side of Chapman Gulch, hydrothermal alteration has effected all the rocks—sedimentary, extrusive, and intrusive. In many places the alteration is so intense that it is impossible to differentiate any of the formations below the Potosi volcanic series. Possibly there are some extremely large sized, low-grade deposits where hydrothermal alteration was especially intense. Extensive sampling would be necessary, however, to delimit them and to determine the grade.

ALTA MINES, INC.

The property of the Alta Mines, Inc., covers considerable ground in Palmyra Basin, Gold King Basin, the ridge between the two basins, and across the ridge at the head of Gold King Basin down into Staatsburg Gulch. The approximate boundary of this property is shown on figure 26, which also shows the levels of the Alta mine, the levels 2 and 4 of the St. Louis mine, the Jonnie drift which joins level 4 St. Louis with the level 5 of the Alta, and the new work from level 8 of the Alta over to the St. Louis ground. Levels 1 and 3 of the St. Louis mine, and the newer work on level 8 in both the Alta and St. Louis ground are not shown.

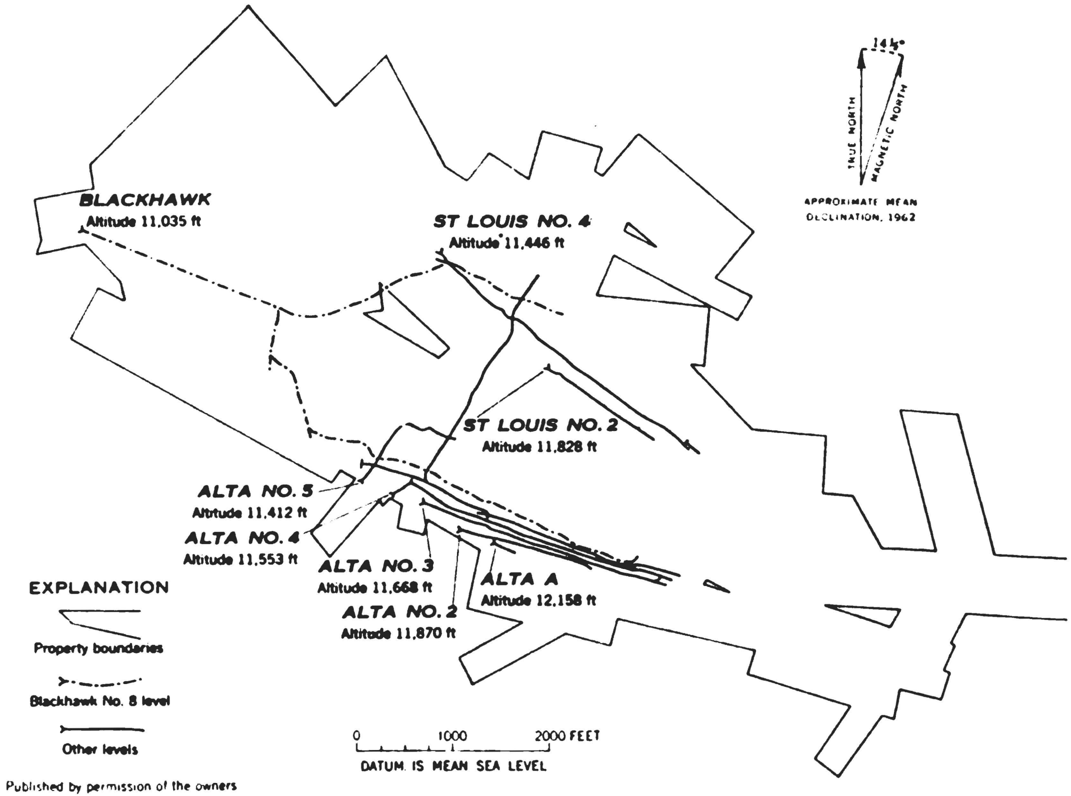


FIGURE 26.—Map showing property boundaries and most of the mine workings (as of 1942) of the Alta Mines, Inc.

The following brief summary of the history of the property is bas on what the author was told by John M. Wagner, a long-time reside of the region who was active in developing and consolidating tl property.

The first claim of this group, the Alta, was staked in 1877. D velopment of the veins in the region was so rapid that by 1879 the Go King Co. had built a 20-stamp mill, and two arrastres were operatir near Ophir. By 1881 the Alta and Palmyra claims had been deve oped sufficiently to prove that ore in paying quantity and grade w present; a year later level 2 of the Alta had 700 feet of developmer on it. Development and production continued on several propertie By 1897 the San Juan Co. had consolidated many claims and built 200-ton cyanide mill. This mill was unsuccessful and a change wa made to stamps and gravity concentration. Operation continued unti 1907, when the company was bankrupt, reportedly because of incom petent management. During this same period the 4-Metals Co. worke the Palmyra-St. Louis property, shipping ore to smelters. The com pany failed but later leasers were somewhat successful.

In 1908 John Wagner acquired the property of the Alta Mining Co., and during the next few years acquired adjoining claims. The mill was operated on Alta ores, and in 1910 the tramline to Ophir was built. In 1913 the Palmyra-St. Louis group was acquired, and the Jonnie drift was driven from the Alta level 5 to the Palmyra vein, the Palmyra vein was drifted on, and a raise driven to connect with the older Palmyra workings. Wagner reports that from 1909 to 1917 the gross production was worth $849,147, and the profit was $627,268.

In 1917 John Wagner and Clyde A. Heller organized the Belmont-Wagner Mining Co., which was active from 1917 to 1924. A large mill was built below the portal of the Blackhawk adit (altitude, 11,035 feet), and this adit was then driven in over 6,000 feet to form the Alta level 8. During the period 1917 to 1924 the Belmont-Wagner Co. mined and milled 126,430 tons of ore, but failed in 1924, because of inefficiency and high metal losses in the mill.

From 1924 to 1929, when the mill was destroyed by fire, John Wagner operated the property, doing development mostly and mining only enough ore to finance the operation.

About 1936 Alta Mines, Inc., took a lease and option on the property, and mined until after the war. In 1948 the mill and much of the surface plant was again destroyed by fire.

There are eight levels on the Alta vein. The ore in the highest five levels was mined out some time ago. Levels 6, 7 and 8 supplied most of the ore more recently. The ore in the Palmyra vein in the St. Louis mine has been mined out from the four upper levels for a dis-

tance of about 2,000 feet at the west end; the eastern extensions of these levels have not been developed. The company has extended a crosscut from level 8 of the Alta over to the Palmyra vein where it developed ore about 400 feet below the old 4th level.

The ore mined during the early years of World War II averaged about 0.10 ounce gold, 4.0 ounce silver, 1.4 percent lead, 0.15 percent copper, and some zinc. The concentrate as shipped average about 0.5 ounce gold, 32 ounce silver, 12.3 percent lead, 1.75 percent copper, and unstated amounts of zinc, for which the company received credit. The table following shows the production since 1901.

The developed part of this property (pl. 22) is entirely in the San Juan breccia. The lowest level is probably not more than 200 feet above the Telluride formation and much of the San Juan breccia in the lowest level consists of fine-grained waterlaid tuff. The volcanic rocks are cut by a number of andesitic dikes, veins and faults, most of which trend from N. 50° to 70° W., and from N. 30° to 45° E. Dips are generally from 60° to vertical.

The veins are, in general, composite and were formed in several stages separated by recurrent movements. The fractures tended to open up along or close to the earlier formed dikes, so that there are few dikes that do not have at least a little mineralized rock along them, and only a few veins that do not follow dikes. The earliest stage of mineralization resulted in the formation of sericite, the introduction of pyrite and calcite, and in places considerable silicification of the country rock. The second stage was preceded by the development of fissures on which there was relatively little movement, and resulted in the formation of discontinuous (en echelon) fissure veins containing galena, chalcopyrite, sphalerite, and tetrahedrite in a gangue of quartz, barite, and rhodochrosite. The next period of fracturing was accompanied by considerable movement which formed rather continuous breccia and clay gouge zones. They cut through and along the earlier fissure veins in some places and in places cut the barren country between them. This period of movement was followed by the formation of vuggy comb quartz veins containing gold. There has been some postmineralization movement along northeastward-trending faults. The veins in the higher levels are considerably oxidized and are richer in gold. The ore in the lower levels may have a higher percentage of zinc than that in the upper levels.

The ore shoots occur in the relatively steep parts of the veins and may occur on the hanging wall, within, or on the footwall of dikes. The structural control is not entirely understood, however, and more complete, accurate surveys of the mine will be necessary before the problem can be solved satisfactorily.

Mine production of gold, silver, copper, and lead from the Alta and St. Lou mines, 1901–57, in terms of recoverable metals

[Prepared by Division of Mineral Industries, U.S. Bureau of Mines. Published by permission of own

Year	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
1901	709	151	41,866		
1902	9,695	799	91,560	4,155	680,8
1903	9,058	57	28,173		252,8
1904	20,170	1,895	117,446		977,7
1905	[1]	2,322	153,669	15,727	1,317,7
1906	15,462	3,096	204,891	68,720	1,756,9
1907	19,990	1,542	115,638	790	418,6
1908	[2]				
1909	13,200	899	45,379	33,280	340,31
1910	19,643	2,428	98,107	45,890	676,75
1911	25,428	2,843	73,798	35,347	442,13
1912	32,095	3,378	99,301	49,312	608,61
1913	27,000	4,233	94,500	46,648	574,03
1914	19,000	2,831	95,836	36,919	792,32
1915	9,636	1,111	19,909	8,094	149,44
1916	15,000	3,134	54,810	26,743	326,04
1917	14,036	1,656	43,755	23,452	265,67
1918	7,079	422	24,705	13,186	107,27
1919	27,338	1,602	100,557	45,234	354,96
1920	20,180	974	63,138	26,738	311,77
1921	20,215	810	82,089	40,162	387,59
1922	42,117	3,637	171,940	40,045	645,54
1923	23,698	1,573	117,668	45,772	435,89
1924	1,350	200	3,666	2,155	23,61
1925	2,700	167	7,919	3,000	43,000
1926	3,450	207	27,347	11,000	103,500
1927	846	79	9,182	6,263	37,310
1928	8,250	220	11,804	6,278	35,673
1929	23	10	1,617	761	6,480
1930	[2]				
1931	14	11	14		
1932	60	61	43		
1933	30	28	16		
1934	20	14	1,225	400	8,500
1935	15	57	459	200	2,200
1936	35	119	729	330	3,980
1937	12,000	524	26,351	23,100	113,030
1938	32,695	2,412	96,578	70,950	363,600
1939	40,403	5,909	66,869	116,350	310,540
1940	45,988	4,756	100,023	67,538	553,397
1941	40,498	2,546	115,330	76,500	928,960
1942	32,683	2,613	110,558	78,800	1,033,634
1943	17,964	1,199	40,676	32,214	471,789
1944	15,000	2,285	30,605	35,407	308,090
1945	40,372	3,589	35,525	90,032	413,932
1946	32,132	3,305	75,822	184,495	472,410
1947	26,079	1,947	24,475	85,812	262,313
1948	24,000	1,186	18,035	47,770	240,679
1949	[2]				
1950	[2]				
1951 [3]	52	67	902	1,770	12,000
1952	[2]				
1953	[2]				
1954	[2]				
1955 [3]	22	25	443	500	3,700
1956 [3]	1	32	29		700
1957 [3]	11	15	183	100	1,700

[1] Ore tonnage unknown. 3,862 tons concentrates.
[2] No production.
[3] Cleanup.

The Alta and Palmyra vein zones are the only ones on which development or mining has been done to any depth. The branching and en-echelon character of the Alta vein suggests the possibility of overlapping or parallel ore shoots, but few of the splits along the main zone have been followed for more than a few feet. At several places conspicuous clay-gouge zones branch off and these have rarely been investigated.

The St. Louis workings are entirely on the Palmyra vein; the St. Louis vein, which joins the Palmyra just west of the Como vein, has never been explored. The St. Louis vein apparently was not discovered underground because it is only a weak altered fracture where it joins the Palmyra and for about 200 feet east of the junction. Farther east on the southwest side of peak 13,470 on Silver Mountain the outcrop of the St. Louis looks even stronger than the Palmyra at the level 8 and there is the possibility of ore on the St. Louis vein which has never been mined. The Hancock vein was drifted on the Alta level 8 for only about 100 feet. There it consists of a fairly wide fractured and altered zone in which some quartz, barite, galena, and chalcopyrite occur. As even the best veins may show low-grade stretches for distances greater than 100 feet, it is felt that the Hancock has not been sufficiently tested at this level. On the surface it has a long, locally conspicuous outcrop, with as much as 6 feet of quartz, barite, and oxidized sulfides, though it does not follow a dike except at its east end. On level 5 it was stoped between the Bessie and the Little Sioux veins, but the workings are caved and could not be examined.

SUGGESTIONS FOR PROSPECTING

Although some small undiscovered high-grade ore shoots may remain near the surface in the South Telluride area, it is believed that large-scale, deep development will be necessary in order to obtain important production in the future. One major difficulty with deep development is the necessity of consolidating under one control an area large enough to justify the expenses involved in exploring at considerable depths. Many of the claims were staked three or four generations ago, with the result that the ownership of the ground is distributed among many heirs now living in widely scattered parts of the country.

ORE CONTROLS

The ore deposits in the area are controlled by fractures for the most part. The most favorable places for deposition of vein minerals were at sites where strong, persistent fault zones cut massive, fairly resistant rock units. The important, known hosts for ore deposits are the San Juan breccia, the Telluride formation, and the Cutler formation; the breccias of the Eureka rhyolite and of the Burns latite are of somewhat secondary importance, because they are not as thick. The Pony Express limestone member of the Wanakah formation may be a relatively favorable host rock because of its easily replaceable character. No great importance is attached to depth relations; the Cutler at the bottom of Bear Creek canyon apparently contained rich gold ore shoots in the Canton mine, and the mines at low altitudes in the

valley of Howard Fork apparently had ore bodies as rich as thos higher altitudes. Mines at altitudes close to 12,500 feet on the so east side of Gold King Basin and in Bridal Veil Basin produced ore in the early days.

Perhaps of some importance, so far as the western part of the a is concerned, is the observation made to the author by Isaac Parte that few important ore deposits occur in the part of the Tertiary tion that is underlain by the shaly upper part of the Morrison for tion or the Mancos shale. This does not particularly affect immediate area under discussion as most of the areas underlain shaly units are covered by the Silver Mountain landslide ma however, northwest of a general line between the Contention mi the Champion mine, and the Smuggler-Union mill, no mines ha been developed. This suggestion may be of even more importan for prospecting north of the San Miguel River.

PROMISING AREAS

In general the areas pointed out below as promising for prospec ing are long-range possibilities, generally reachable only by lon expensive workings, so it is believed that considerable diamond dril ing should be done as a first stage of exploration.

The Dividend and Royal gold-bearing zones are believed to be to spotty as far as rich ore shoots are concerned to justify the cost of deep southward-trending crosscut at some depth at or below the alti tude of the Telluride formation, unless the price of gold is advanced considerably. The long adit, 1,500 feet S. 25° W. from Bridal Vei Falls (altitude 10,818 feet on pl. 16 and pl. 18), might be used, however, to explore, at no great cost, the Dividend structure in the San Juan breccia west of Bridal Veil Creek.

The large area at the upper end of Bridal Veil Basin, between the Little Dorrit mine and the Lewis mine and from Bear Mountain on the west to Bridal Peak on the east would seem to be a favorable area for exploring for veins containing base metals, silver and gold, inasmuch as here base-metal minerals were observed up in the usually unfavorable Potosi volcanic series and in the underlying flows of the Burns latite. But to explore this area at depth, after some probing by diamond drilling, would require a long adit from some point such as at the lower end of Chapman Gulch, near the old road. Such an adit, however, could also aid in the exploration of the large alteration zone on the north side of the valley of Howard Fork, of the breccia pipes at depths, and of the west and west-northwest fracture zones south of Bridal Veil Basin.

The intersection on Ballard Mountain of the westward-trending Champion-Dividend zone with the south-southwestward-trending

Boundary zone (the Weller area) appears to be a good place to prospect for gold at depth. The many gold-bearing veins of diverse trends at the surface may coalesce into fewer veins at depth, but there is no apparent reason why these veins should not bear gold in at least the Cutler, Telluride and San Juan formations. An adit driven eastward from a point on the east side of Bear Creek near the mouth of La Junta Creek would reach the center of the favorable area in about 3,800 feet. Of course, under the present price of gold, such work probably is not attractive, but with a rise in the price of gold, justification could be made for such a project. Another project which would be much more attractive under a higher gold price would be a long, deep crosscut below the ridge between Bear Creek and La Junta Basin. Such a southward-trending crosscut would intersect about 10 possible gold-bearing veins between La Junta Creek and the Nellie-Wasatch zone. A southwestward-trending crosscut under the ridge on the west side of Bear Creek might also be suggested, but westward, more and more of this ridge is underlain by shale of the Morrison formation, and, therefore, the Telluride formation and the San Juan breccia there cannot be considered as being as favorable as on the east side of the creek. If the shale beds acted as a dam during mineralization, however, this would make the rocks underlying them even more favorable hosts for ore, providing that mineralizing solutions were available as far west as that.

The Delta area (p. 284) seems to be a favorable area to prospect for both base metals and silver and gold. As it will be expensive to put mine workings deep in this area, it probably should be tested carefully by deep diamond drilling before such workings are considered.

The general area around Silver Mountain probably has several favorable zones at depth in which base metals, gold, and silver are present. Among the better structural zones that have had production in the San Juan breccia and to some extent in the Eureka rhyolite are the Palmyra, Hancock-Arlington, and Alta veins of northwestward trend, and the Bessie, Little Sioux, Dixie-Crown Jewel, and Summit-Tiptop veins of northeastward trend (pl. 22). A 7,000- to 8,000-foot adit from some locations such as that of the Badger tunnel, at altitude 9,625 feet, driven north under peak 13470 on Silver Mountain, would not only give a chance for exploration of all these veins, but could also be used as a starting point for exploration at depth below the general Gold King-Suffolk area.

A deep exploration adit below the Carbonero-Highline area probably would not only intersect a number of argentiferous base-metal veins lying in the broad zone trending N. 65° E. but also would give

the opportunity to obtain bulk samples of the intensely altered country rock in this area. However, such deep exploration as this, as well as most of the exploration recommended in this chapter, should be preceded by some deep diamond drilling in order to get some idea of the size and location of the deposits being sought.

EARLY DATA ON TELLURIDE AREA

The quotations below are from C. W. Purington's field notes (1896) and information from H. C. Burchard's Reports to the Director of the Mint (1881–85) regarding many mines in the southern part of the area. Much of Purington's information was never published, except in very generalized form in the 18th Annual Report of the U.S. Geological Survey (1898), and in Folio 57 of the Geologic Atlas (Cross and Purington, 1899), and it seems worthwhile to make his observations available, even at this late date. Many of the mines have not been located during the present study, and the approximate location of others, as far as can be estimated, is indicated in parentheses before the quotation.

Attica mine, Iron Springs district:

Probably the caved adit located about 2,000 feet N. 56° E. from lower portal of New Dominion mine. Purington, field notes, 1896.

Located on Silver Mountain about one mile ENE of the town at 10,500′—a mere prospect. 2 levels both cc. [crosscut?]. Lower strikes N 48 W 430′ long; upper 255′ E of it strikes N 27 W. Main vein strikes N 80 E dip 70° N seen only 4″ wide—white quartz and galena. Other small veins cut in c.c.

In the upper tunnel slickensides seen Str N 65 W dip SW 80° also groovings. No ore has been shipped from here but I am told on good authority that with its own mill this mine would pay. Its principal value is in gold, tho' a good bit of silver accompanies.

Badger, Iron Springs district:

Purington, field notes, 1896.

This is situated on the S. slope of Silver Mountain, ½ mile NW of the town of Ophir. It has been worked considerably but I think not a great deal of ore has been taken out. The workings consist of the Hathaway tunnel which is a cc and cuts the main vein at about 1000′; the upper tunnel 285′ vertically over which cuts the main vein at 300′—and about 1000′ of drifting on the vein. Tho' merely in the prospect stage, the mine is well opened, and the work is practically all of development character. The property is owned by Mr. ?. G. Hathaway of Denver, Colorado.

Country is of a mixed character. The lower tunnel starts in a diorite, which it penetrates for a distance of 100′; then hard silicified shale is encountered, the contact of which with the diorite dips to the S.E. The shale is the Gunnison of the Jura and has a very curious silicified and metamorphosed appearance. It is intensely hard. Much of it is of red and green jasper-like character. The red and green parts are in the form of elongated lenses.

Through the shale penetrate narrow dikes of the diorite which cut in several directions. The strike of the shale beds is N 60 E dip 10 SE. Some faulting of dikes one by another is seen. The dikes are slightly finer in grain than the mass of the diorite. I saw none more than 6″ in width. In the upper tunnel the coun-

try is the shale—but so fresh exposures of it are not seen. It gets into conglomeratic stuff at its N end. The fissuring in this mine is typical of the mountain-jointing here. In the lower tunnel sets of fissures strike N. 86 E, others strike N 60 W, one set of joints strikes N 45 W. Along the first of these three veins occur up to 3′ in width. 200′ in a vein strikes 85 E of N which is indeed the direction of the main or Badger vein. The veins are later than the dikes, as are all the fissures. A number of small veins have been found running in directions 15 W of N to N–S. It has not been found that any of these veins are so good here as the main E-W running vein. None of the veins seem earlier or later than others, but to have been filled at the same time. The dip of the veins is to the south. The ore is for the most part quartz gangue of finely crystalline character. The minerals are iron pyrite, and smaller amounts of zinc blende and galena associated with calcite. The ore body averages 4′ in width and has more the character of a single vein than is usual in these deposits. The gold is contained partly in the sulphurets, but is more than usually free. In the drift of the Badger it is said that the country rock is impregnated with auriferous pyrite to the extent of $8 per ton. Manganese oxide is very common in the vein and is said to be favorable to the occurrence of ore. Free gold occurs in thread form in the white vug-like quartz and has been seen in calcite. Silver values are almost nothing in the vein. From the undecomposed sulfides the gold may be mechanically panned and $17 a ton is the average yield. Small cross veins are crossed in the Hathaway tunnel which are found to carry $4 in free gold beside auriferous sulfides.

Crown Jewel, Lower San Miguel district:

See plate 22 of this report. Burchard (1883, p. 521).

The Crown Jewel has 150 feet of tunneling on a galena and gray copper ore vein, several tons of which have been shipped.

Burchard (1884, p. 424).

The Crown Jewel, on the Ophir side of the range, is an extension of the Palmyra, in Turkey Creek. The mineral of this claim is a fine-grained galena thickly impregnated with gray copper that averages 150 ounces silver and 30 per cent lead per ton. The mine is opened by drifts that aggregate 600 feet.

Globe, Iron Springs district:

Probably somewhere close to and east of the Suffolk mine. (Burchard, 1883, p. 523).

The gold veins of this district have been but little worked during the year, with the exception of the Globe mine, from which 5,000 pounds of ore were shipped to Denver.

Burchard (1884, p. 425).

Shipped in 1883

Tons ore	Oz Ag	$Au	Lbs Pb
7	------	910	------

Burchard (1885, p. 247).

The Globe, on Silver Mountain, has a tunnel of 125 feet, with a pay streak, while the Suffolk, near by, has a 100-foot drift, showing a decomposed vein from 4 to 12 feet wide, with some gangue matter.

Gold Crown, Iron Springs district:
Purington, field notes, 1896.

This is situated NNW of the town of Ophir at 10,600'—at the horizon of t San Miguel conglomerate. Worked by a CC 200' long and drift on one vein 9(and an opening on a cross vein. All on one level. The CC strikes N 3 E. T workings has just been started and 55 tons a day is being put through—a tra connects the mine with the Suffolk mill in the valley below. The country is part San Miguel conglomerate and farther in the San Juan formation. The have a dip to the N—the rock is greatly decomposed throughout, tho' not picki ground. Very large pebbles even boulders occur in the San Miguel of quartzit slate, and basic igneous rocks. Much brown iron-oxide staining is throughou the mine.

The main vein strikes 80° W. of North—another strikes 80 E of N and th third, called the Belcher vein strikes N 40 E dip 70W—the two E–W veins dip t the S steeply. The main vein dips N a part of its course. The main vein change in appearance from the conglomerate to the andesitic breccia.

In the cg it is much brecciated, a rather crushed zone appearance, while in th breccia itself it is much more of the linked vein character, having a few large horses rather than many small fragments. This is due to a difference in me chanical consistency of the rocks and seems to affect the values for the worse. Whether any chemical effect is also responsible I don't know. It seems that the rocks having the chemical makeup of the andesite are in the San Juan the most favorable for the occurence of ore. 18'' ave. width. Decomposition is so far advanced that it is often difficult to distinguish any now metallic constituents. Gold was undoubtedly originally contained mostly in pyrite or at least accompanying, but the dissemination of this pyrite is puzzling. Whether it was contained in veins, or in the cement of the conglomerate is uncertain. It is said the ore milled when I visited the mine ran $5 to the ton. It seems to me that a considerable portion of the ore is merely the country rock which is throughly impregnated for short distances from the veins.

Gold Eagle, Iron Springs district:
Burchard (1885, p. 247).

The Gold Eagle is a new discovery. A drift of 125 feet has been run on the vein, showing 2 feet of pay ore, which is being taken out in large quantities and sacked for shipment.

Gold King, Lower San Miguel district:
Burchard (1883, p. 521).

The Gold King has a 4-foot pay streak, the ore from which averages by mill run $50 in gold per ton. Owned by Messrs. Brown and Warner.

Gold King extension, Lower San Miguel district:
See plate 22 of this report. (Burchard, 1883, p. 521).

The Gold King extension has 3 feet of gold ore and 50 feet of development.

Grand View, Iron Springs district:
Burchard (1884, p. 425).

Shipped in 1883

Tons ore	Oz Ag	Lbs Pb
8	3,600	2,400

Burchard (1885, p. 247).

is located on the summit of Silver Mountain, near Ophir, and is now producing from 4 to 5 tons of good ore per day, with a small force of men * * *. The upper drift of the Grand View is in 127 feet and the lower drift 85 feet, a portion of which has been run through slide rock.

Lookout, Iron Springs district:
Burchard (1883, p. 522).

The Lookout has a 60-foot shaft with a 60-foot drift from the bottom, both on vein; a cross-cut to reach the vein at 300 feet is nearly in. Two pay streaks are found on the Lookout, one of galena and one of chlorides. Lookout ore averages at mill 135 ounces per ton. Both Tip Top and Lookout are shipping ore.

Burchard (1884, p. 423, 425).

The Lookout is worked by a cross-cut tunnel that cuts the vein about 300 feet from the surface.

Lookout and Tip Top shipped in 1883

Tons ore	Oz Ag	Lbs Pb
160	9,600	160,000

Lookout Tunnel, Iron Springs district:
Purington, field notes, 1896

This is located N of the town—elevation of 600′ and the horizon of the San Miguel conglomerate at its lower edge. No vein has been found in it, but the entire mass of the cg which, by the way, is in a remarkably fresh condition, is impregated with iron pyrite and has a very siliceous cement, so much so that it seems highly probable that a secondary silicification has taken place, probably from infiltration of ore-bearing solutions. The great number of small veins which I know to penetrate this part of the district furnish abundant source for ore solutions which have worked through the permeable conglomerate, and mineralized the cement. This same conglomerate may be seen along the mountain side for 1000′ having a brown-stained appearance and doubtless mineralized for its whole length. This is the only locality where I have seen the San Miguel mineralized to such an extent, and I do not doubt that it is a auriferous, tho′ whether in paying quantity or not as a whole I am not sure. As hereafter stated, I have seen in the Gold Crown mine ore which is practically nothing but the mineralized conglomerate. It has been stated to me that the conglomerate away from any workings sampled runs in gold as high as $8 a ton.

Minnie Myrtle, Lower San Miguel district:
Burchard (1883, p. 521).

The Minnie Myrtle has about 250 feet of development. The ore carrics both gold and silver. The owners of these mines erected a 10-stamp mill with vanners in 1880, and are increasing the capacity by 10 stamps. Their mines are located high on the mountain, and the ore is taken to the mill by a Hallidie tram 2,600 feet in length.

Mohawk, Iron Springs district:
Burchard (1883, p. 523).

The big San Juan Mining Company commenced operations on the Mohawk mine in September. This mine is on Silver Mountain, near Ophir, some 2,000

or 2,500 feet higher than the town, and about 12,000 feet above sea-level. It is a true fissure carrying galena and oxidized lead ores with some gray copper and iron pyrites; also native silver in small quantities. The developments are 100 feet of shafts and 175 feet of drifts. The production, owing to the limited time the mine has been in operation, was small; the ore averaged 113 ounces of silver to the ton and 34 per cent of lead.

Burchard (1884, p. 425).

In 1883 shipped

Tons ore	Oz Ag	Lbs Pb
2	232	960

Burchard (1885, p. 247).

The Mohawk has a drift of 170 feet; shaft down 100 feet; drift from bottom of shaft 35 feet. Some ore has been shipped, which runs 153 ounces silver and 40 per cent lead.

Osceola, Iron Springs district:

Burchard (1882, p. 420).

In the vicinity of Ophir in Iron Springs district, 10 miles south of San Miguel, are a number of mines located on Silver and Yellow Mountains and on Wilson Creek. The ore is high grade, although the veins are narrow, the widest being that of the Osceola mine.

Burchard (1883, p. 523).

There are numerous gold-bearing lodes in the district, but they are chiefly in the hands of their discoverers, and have been but little developed, with the exception of the Osceola group, which shows a large amount of excellent gold quartz.

Palmyra, Lower San Miguel district:

Burchard (1883, p. 521).

The Palmyra has a 300-foot tunnel, ore gray copper and galena in iron spar gangue, vein 5 feet, ore streak 18 inches, average assay 300 to 900 ounces.

Parnell, Iron Springs district:

Burchard (1885, p. 247).

The Parnell is a late discovery on Silver Mountain, and has been opened only 6 feet in depth, from which about 10 tons of ore were taken.

Red Jacket, Iron Springs district:

Purington, field notes, 1896.

This is situated ½ mile directly W of the Gold Crown mine, and altho quite elaborate, is not greatly worked now. The intention is to work this extensively in the coming spring. The elevation is 10700′, and in common with the mines at this elevation, with deficient transportation, work usually has to be suspended in the winter time.

The country is here so far as exploited the San Miguel conglomerate and has the same decomposed appearance noticed in the Gold Crown.

The vein strikes 50 W of N and is faulted 500′ in, the NW part being thrown to the SW 50′. The veins are here indistinct, and have no well defined con-

tinuity but partake of the character of link veins; so little product has been made from this mine that one can hardly tell what the ore is worth. It is said to pay to work with the existing conditions, a tram wire way down to the mill at the town and a 50 stamp mill which may be put into requisition.

Santa Cruz, Iron Springs district:

Burchard (1884, p. 425).

Shipped in 1883

Tons ore	Oz Ag	$Au	Lbs Pb
35	2800	36	21.000

Purington, field notes, 1896.

Situated NW of the town of Ophir about 600′ NW of the upper tunnel opening of the Badger mine and 200′ farther up slope. It is not much more than a prospect—only about 700′ of work having been done. A vein 200′ in strikes 80 E of N–dip N. The vein carries iron and copper pyrites and galena and has yielded high silver values which is rather remarkable considering its situation. Here again a faulting of the fissures occurs as noted in the Suffolk. It is *not* a fauiting of the veins. The Winnemucca vein crossed 30′ in the west drift of the Santa Cruz vein—strike 30 W of N–dip 80 SW. This faults the Santa Cruz vein 10′, the W part of it being shifted to the N. The evidence of any motion having taken place after the veins were formed is, it seems to me, scanty throughout the region.

The country is sandstone.

The ore carries $60 in silver and 1½ oz Au. In Nettie gulch the beds dip SW and in a little gulch just W of the Badger mine the cg is impregnated with iron pyrite said to run $2.50 per ton in gold.

Single Standard, Iron Springs district:

Purington, field notes, 1896.

This and other claims of L. L. Nunn on the S side of Silver Mountain are situated at about 12,000′ elevation directly N of the town of Ophir. The mine was worked most extensively in 1890, and produced then 1600 tons valued at $8 per ton.

The country is the andesite breccia and makes the rock for 300′ above this point, where it is overlain by the more massive andesite. It is here greatly decomposed, as is the rock generally on this mountain side, and on the north side so far as I have seen, altho' to a less extent on the north side than on the south. This decomposition is due for the most part to the large amount of iron pyrite which impregnates the rock.

The veins worked on appear to be several and strike in various ways, the main one seems to be N 80 E. Bunches of narrow veins of vug character cut the andesite and are in the characteristic zone or linked form which is so common through the country. The country is much impregnated along the sides, but they tell me that it carries only a trace in gold.

As seems likely from the appearance of the mine, the ore is 90% free milling and the value was gold. It was packed on burros and taken down to a 20 ton mill in the valley below. Other claims in this group are El Mundo, Bijou, Little Eva, Bonita.

As noted before, the permeation of all the rock on Silver Mountain by solutions which deposited iron sulphides must have been very extensive. The deep gulches worn out along this side are caused by zones more extensive than usual, or more

thoroughly pyritiferous. One of these—¼ mile E of the Single Standard has a zone 50′ wide—strikes 20° W of N, dips 70° to the E.

Staatsburg, Iron Springs district:
Burchard (1884, p. 425).

Staatsburg is listed as a producer, but its output is not tabulated separately.

Suffolk, Iron Springs district:
Purington, field notes, 1896.

This located high on Silver Mt., the lowest working being at 11500′ and the upper workings going to the top of the divide nearly and connecting with the drifts of the Gold King mine on the north side of the divide. The workings consist of about 3000′ of drifting and much stoping. There are five levels on only three of which has extensive work been done. The country so far as I saw it is decomposed breccia, while the upper workings penetrate the andesite and have no different appearance from the lower rock so great is the pyritic staining.

The most interesting point illustrated by the Suffolk mine workings is the complexity of the fissuring. The Suffolk vein, so called, strikes N 30 W and this is crossed in the mine workings by two which are 100′ apart and are called the Globe and Globe Parallel. These strike N 12 E and in their N extent the ore is taken by fissures which strike N 15 W and N 30 W respectively. The Suffolk vein on the 2nd level 500′ in throws the Globe Parallel vein 8′—the S part to the W. The Globe and Globe Parallel veins dip to the W. The Yellow Girl which has practically same strike dips east. The result is that these 2 veins nearest each other practically come together in the lower level of the mine, but have not as yet been found to cross.

The Yellow Girl vein which has been one of the most productive in the mine is very narrow and is high grade.

The abrupt changes which occur on this hill-side in the directions of veins illustrate the fissure systems which prevail on it and which seem to be more evenly developed than in any other part of the Telluride district. The result of this non-prominence of one over another is that the veins are scattering and not so apt to be good, as one fissure will peter out and another take the ore off in a different direction. It is only when the veins are very numerous and the country is thoroughly impregnated that the ore is pay. There the choice of ore is not limited to the mere quartz but several feet on each side may be taken and put through the mill, so far as the impregnation extends.

The gold is doubtless originally contained in iron pyrite tho' I have specimens showing a considerable amount in the quartz apart from any decomposition stain.

The Yellow Girl ore runs $50–75 per ton. The larger veins run much lower even down to $5. By reference to the assessors ????? on p. 46 (this book) the product of the Suffolk-Gold Crown etc. may be had. These two and the Red Jacket are under the same management as that of Mr. Scoutt. This gentleman informs me that the gold runs 650–700 fine. Almost no silver accompanies. The ore is treated in a 40 stamp mill in the valley below to which the ore is conveyed in gravity bucket trams. The concentrates run very low, and tailings $1 per ton. The last seems surprisingly high in such low-grade ore; punched slot screens are used in the mill giving better satisfaction than anything else after many trials. The mill is operated by water, as is also the Carribeau mill. Abundance of water power in the valley.

Summit, Iron Springs district:

Probably southwest of Tiptop claim, see plate 22 of this report.

Burchard (1883, p. 522).

The Summit mine is situated on the divide between Iron Springs and Upper San Miguel districts, or on top of the range between Ophir and Turkey Creek Basins. The development consists of an upper tunnel of 350 feet; tunnel No. 2, 530 feet, the two connected by a winze. Both tunnels and winze are on the vein, which is a clearly-defined fissure, 5 feet between walls, and a shaft 40 feet from tunnel No. 2, also on the vein. Below these workings tunnel No. 3, a cross-cut, is in 135 feet. The ore, a sulphuret and galena, averages in large lots 150 ounces silver and a good percentage of lead. About 700 tons of ore have been shipped to Silverton, which averaged about 175 ounces of silver to the ton.

Burchard (1884, p. 422–423).

On Lookout Mountain the Summit mine has been continually shipping ore. A cross cut tunnel intersects the vein about 500 feet from the surface, where levels are run disclosing large bodies of ore. The other developments consists of two drifts. The upper drift is 390 feet, the lower one 610 feet long. Winzes connect these drifts. The vein is about 5 feet between walls, the pay streak about 2 feet.

Burchard (1884, p. 425).

In 1883 shipped

tons ore	Oz Ag	Lbs Pb
140	18,480	140,000

Burchard (1885, p. 247).

produced some good ore.

Purington, field notes, 1896.

1894 output—$14,495.15

Tip Top, Iron Springs district:

Burchard (1883, p. 522).

The Tip Top and Lookout, adjoining the Summit, belong to the Duquesne Mining Company of Pittsburg, Pa. The Tip Top is worked through the upper tunnel of the Summit, having a 150 foot drift. The ore in quantity and quality bears a marked resemblance to the Summit ore.

Burchard (1884, p. 423).

[The Lookout and Tip Top] have been worked considerably, having kept a train of 75 jacks busy packing ore to the Ames smelter. The character of the ore is sulphurets and galena, averaging 150 ounces silver per ton and 28 percent lead.

Valley View, Iron Springs district:

Burchard (1885, p. 247).

The same parties [as Sulphurette] have a lease on the Valley View. Drift No. 1 is 110 feet; about 250 feet from this, No 2 is in 115 feet. The third level, being just commenced, is in only a short distance. No stoping has been done.

The pay streak averages from 6 to 8 inches, giving 244 ounces silver and 36 percent lead. Character of mineral, galena and sulphurets.

Windsor, Iron Springs district:
Burchard (1885, p. 247).

About 1000 feet below the Summit is the Windsor, which is being worked by a shaft down 55 feet, showing a strong vein 4 feet wide, producing galena and carbonized lead, running 200 ounces.

LITERATURE CITED

Anderson, C. A., 1933, Tuscan formation of northern California, with a discussion concerning the origin of volcanic breccias: California Univ., Dept. Geol. Sci. Bull., v. 23, no. 7, p. 215–276.

Atwood, W. W., and Mather, K. F., 1932, Physiography and Quaternary geology of the San Juan Mountains: U.S. Geol. Survey Prof. Paper 166.

Bastin, E. S., 1923, Silver enrichment in the San Juan Mountains, Colorado: U.S. Geol. Survey Bull. 735–D, p. 65–129.

Burbank, W. S., 1930, Revision of the geologic structure and stratigraphy of the Ouray district of Colorado, and its bearing on ore deposition: Colorado Sci. Soc. Proc., v. 12, no. 6, p. 151–232.

——— 1933, Vein systems of the Arrastre Basin, and regional geologic structure in the Silverton and Telluride quadrangles: Colorado Sci. Soc. Proc., v. 13, no. 5, p. 135–214.

——— 1935, Geologic guides are sought for ore development: Eng. and Min. Jour., v. 136, no. 8, p. 386–392.

——— 1940, Structural control of ore deposition in the Uncompahgre district, Ouray County, Colorado: U.S. Geol. Survey Bull. 906–E, p. 189–265.

——— 1941, Structural control of ore deposition in the Red Mountain, Sneffels, and Telluride districts of the San Juan Mountains, Colorado: Colorado Sci. Soc. Proc., v. 14, no. 5, p. 141–261.

Burchard, H. C., 1881–1885, *in* Reports of the Director of the Mint upon the production of the precious metals in the United States during the calendar years 1880, 1881, 1882, 1883, and 1884.

Cross, C. W., Howe, Ernest, and Ransome, F. L., 1905, Description of the Silverton quadrangle: U.S. Geol. Survey Geol. Atlas, Folio 120.

Cross, C. W., and Larsen, E. S., 1935, A brief review of the geology of the San Juan region of southwestern Colorado: U.S. Geol. Survey Bull. 843.

Cross, C. W., and Purington, C. W., 1899, Description of Telluride quadrangle: U.S. Geol. Survey Geol. Atlas, Folio 57.

Eckel, E. B., 1949, Geology and ore deposits of the La Plata district, Colorado: U.S. Geol. Survey Prof. Paper 219.

Henderson, C. W., 1926, Mining in Colorado: U.S. Geol. Survey Prof. Paper 138.

Howe, Ernest, 1909, Landslides in the San Juan Mountains, Colorado: U.S. Geol. Survey Prof. Paper 67.

Hurst, M. E., 1922, Rock alteration and ore deposition at Telluride, Colorado: Econ. Geology, v. 17, no. 8, p. 675–702.

Kelley, V. C., 1946, Geology, ore deposits, and mines of the Mineral Point, Poughkeepsie, and Upper Uncompahgre districts, Ouray, San Juan, and Hinsdale Counties, Colorado: Colorado Sci. Soc. Proc., v. 14, no. 7, p. 287–466.

Larsen, E. S., Jr., and Cross, Whitman, 1956, Geology and petrology of the San Juan region, southwestern Colorado: U.S. Geol. Survey Prof. Paper 258.

Larsen, E. S., Irving, J., Granger, F. A., and Larsen, E. S., Jr., 1936, Petrologic results of a study of the minerals from the Tertiary volcanic rocks of the San Juan region, Colorado: Am. Mineralogist, v. 21, no. 11, p. 677–701.

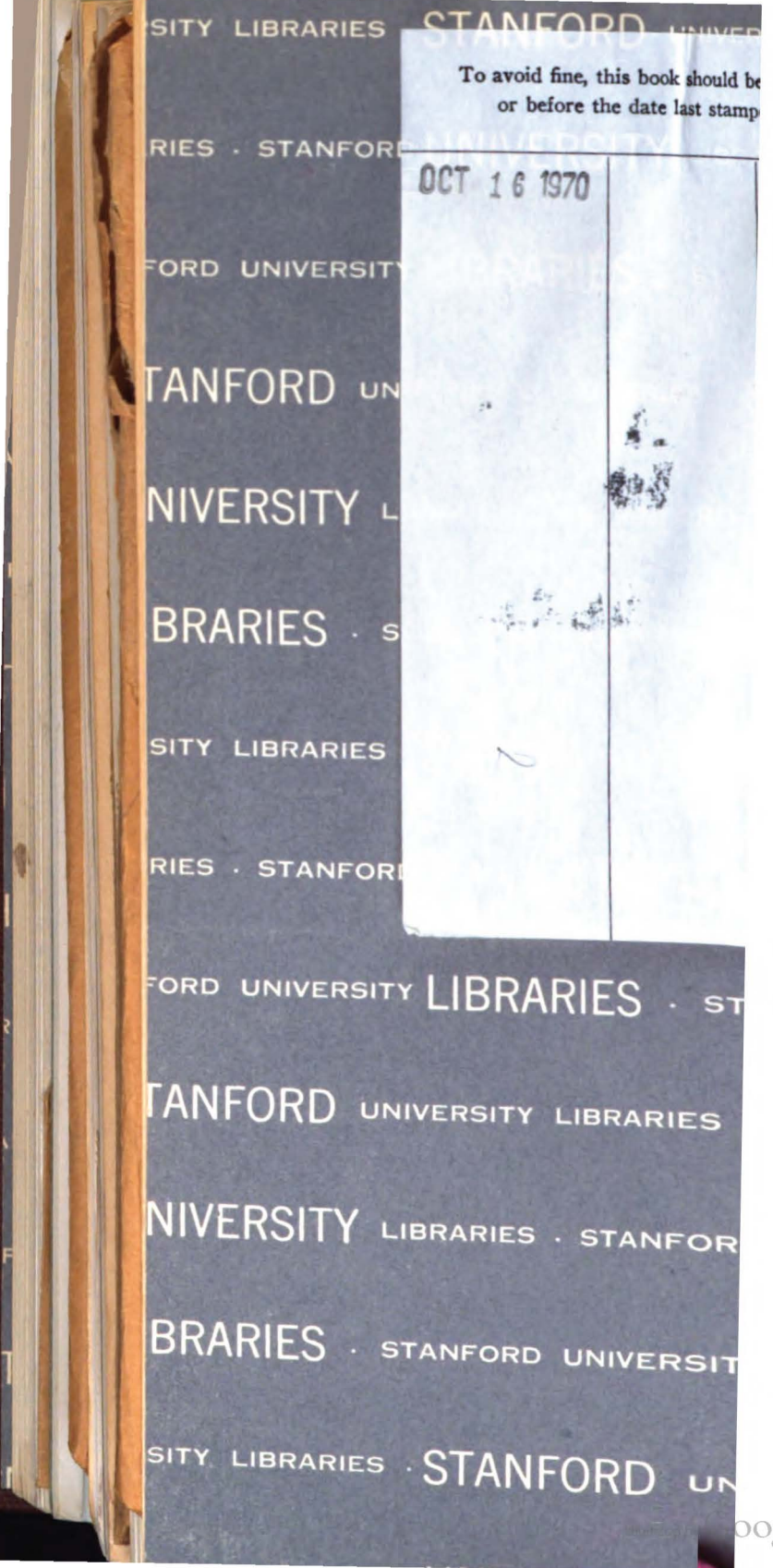
Purington, C. W., 1898, Preliminary report on the mining industries of the Telluride quadrangle, Colorado: U.S. Geol. Survey 18th Ann. Rept., pt. III–f, p. 745–850.

Ross, C. S., and Kerr, P. F., 1931, The kaolin minerals: U.S. Geol. Survey Prof. Paper 165–E, p. 151–176.

Varnes, D. J., in press, Geology and ore deposits of the South Silverton mining area, San Juan County, Colorado: U.S. Geol. Survey Prof. Paper 378–A.

Williams, Howel, 1941, Calderas and their origin: California Univ., Dept. of Geol. Sci., Bull., v. 25, no. 6, p. 239–346.

INDEX


SITY LIBRARIES STANFORD UNIVER
To avoid fine, this book should be
or before the date last stamp
OCT 16 1970
RIES · STANFOR
FORD UNIVERSITY
TANFORD UN
NIVERSITY L
BRARIES · S
SITY LIBRARIES
RIES · STANFOR
FORD UNIVERSITY LIBRARIES · ST
TANFORD UNIVERSITY LIBRARIES
NIVERSITY LIBRARIES · STANFOR
BRARIES · STANFORD UNIVERSIT
SITY LIBRARIES · STANFORD UN